AD-3: Redesign Terminal Airspace and Routes

Terminal airspace and route redesign.

Background

Current congestion in transition and en route airspace often limits the ability to get departing aircraft off the ground. Similarly, airspace congestion can limit arrivals, even if runway capacity is available. In many terminal areas today, arrival and departure procedures overlap either because they were designed for lower volumes and staffing, or because they are based on ground-based navigation. These routes are strongly interdependent. Many airports have common departure fixes or arrival fixes that must service a variety of aircraft types with different performance characteristics. By requiring departures to navigate or funnel through common departure fixes, the throughput rates at the airports involved must be suppressed. Similar problems exist with arrivals.

Terminal airspace optimization and redesign is a foundation component of the National Airspace redesign. Terminal airspace optimization efforts are ongoing initiatives to ensure the airspace design and use is effective for transitioning aircraft to and from the associated airport or airports. Terminal airspace redesign is a major undertaking to develop a structure that takes full advantage of evolving technologies and aircraft capabilities. This redesign will provide flexibility for system users to efficiently transition into and out of terminal airspace while making maximum use of airspace and airport capacity.

Where volume has increased and the current airspace structure is the limiting factor, redesigning these procedures, including the addition of RNAV procedures, will allow for more efficient use of the constrained terminal airspace. Area Navigation, or RNAV, is a method of navigation that permits aircraft operations on any desired course within the coverage of station referenced navigation signals or within the limits of self contained system capability or combination of these. The acronym “RNAV” has been adopted by industry as an umbrella term that encompasses any procedure or operation that utilizes point to point navigation, from ground or air-based/space-based sources. The expectation is that in the future, this will evolve away from dependence on ground-based navigation resources. This is manifested through use of on-board avionics and flight management systems (FMS).

RNAV technologies offer several operational improvements:

- RNAV procedures in terminal airspace can reduce complexity and increase efficiency in the near and mid-term. When designed collaboratively, the procedures require minimal vectoring and/or communications between the flight crews and the ATC controllers. These procedures can be used to reduce voice communications associated with speed and altitude instructions, freeing up more controller time. The procedure, when implemented, describes a flight path that includes position, altitude, and time.
- Reducing spacing on the arrival route structures to the existing separation standards can be accomplished in the long-term through pre-planned navigation routes and speed control techniques (planned for 50 airports). This concept deals with developing

procedures that include the assignment of altitudes and speeds at waypoints located along the FMS/RNAV procedure.

Ops Change Description

The operational change described here includes three concepts to reduce interdependencies between arrival and departure flows:

- AD-3.1: Use existing airspace structures and apply traffic management strategies to depart aircraft through congested transition airspace. Capping and tunneling techniques are included as part of the National Airspace Redesign System Choke Points program.
- AD-3.2: Restructure arrival and departure routes to be independent of navigation aids, using existing RNAV technologies RNAV route development is a primary function of Air Traffic procedural development and a foundation element of the National Airspace Redesign.
- AD-3.3: Optimization and redesign of the terminal area airspace and operations. Terminal optimization and redesign projects are a key component of the National Airspace Redesign.

Benefits, Performance and Metrics

- Increase on-time departures.
- Increase airport capacity utilization effectiveness.
- Reduced excess gate times (duration and/or occurrence).
- Reduction in en route delay.
- Arrival rates percent effectiveness increase for airports where the en route transition sectors suffer high frequency congestion (e.g., ATL northeast arrivals).
- Allows controller to deliver the aircraft with reduced restrictions and vectoring.
- Workload reductions so controllers can reduce restrictions to aircraft and close up spacing to the separation standard.
- Assuming that the use of RNAV is the primary flight practice for arrivals, the percent of control transmissions per aircraft can be reduced per day by the following estimates[1]:

[1] Estimates are generated based on real world experience of actual transmission reductions at several current locations. Estimates are based on current levels of equipage and estimate of current transmission per flight in the terminal area at these locations. Estimates are for airport specific populations.

Airport	Percent	Airport	Percent	Airport	Percent	Airport	Percent	Airport	Percent
BOS	29	ATL	32	DFW	33	LAX	27	MSP	23
EWR	38	MIA	28	STL	17	PHX	33	OAK	19
ORD	42	PHL	37	LAS	37	DEN	37	DTW	20

- The reduction in number of air/ground communications will reduce controller and pilot workload, as well as mitigating the advent of frequency congestion issues in the future. Overall effect is to maintain maximum utilization of available runway capacity.

AD-3.1 Expedited Departure Routes

Scope and Applicability

Two traffic management techniques are being used in the near- and mid-term to expedite departures into congested transition airspace:

- LAADR (Low Altitude Alternate Departure Routes) is a program that allows aircraft to take off, climb to a lower altitude and then achieve their desired/requested altitude later in the flight. Aircraft can proceed to desired altitude as soon as controller clears them. A Letter of Agreement (LOA) is needed between participating facilities along with agreements from participating airlines. This program is facilitated by the ATCSCC. Two LAADR Memoranda of Understanding (MOUs) exist: STL and PHL.
- As part of National Airspace Redesign Choke Points activities, TAAP (Tactical Altitude Assignment Program) is being explored as a viable method to get traffic operating in less congested altitudes, though perhaps these altitudes are less optimal in terms of fuel usage. TAAP is expected to reduce en route congestion and has potential benefits of getting aircraft off the ground sooner, although filing TAAP does not guarantee that the flight will depart sooner. TAAP is voluntary for airline participants (they must file TAAP routes) and involves flying at lower altitudes for shorter length flights. Flights that operate under TAAP are expected to fly at the lower altitudes for the whole length of the flight, and neither the pilot nor controller is supposed to climb the aircraft for efficiency purposes. Routes, between over 100 city pairs, within eight ARTCCs in the Great Lakes corridor, Northeast, and Mid-Atlantic have been identified and agreed upon for TAAP.

Key Decisions

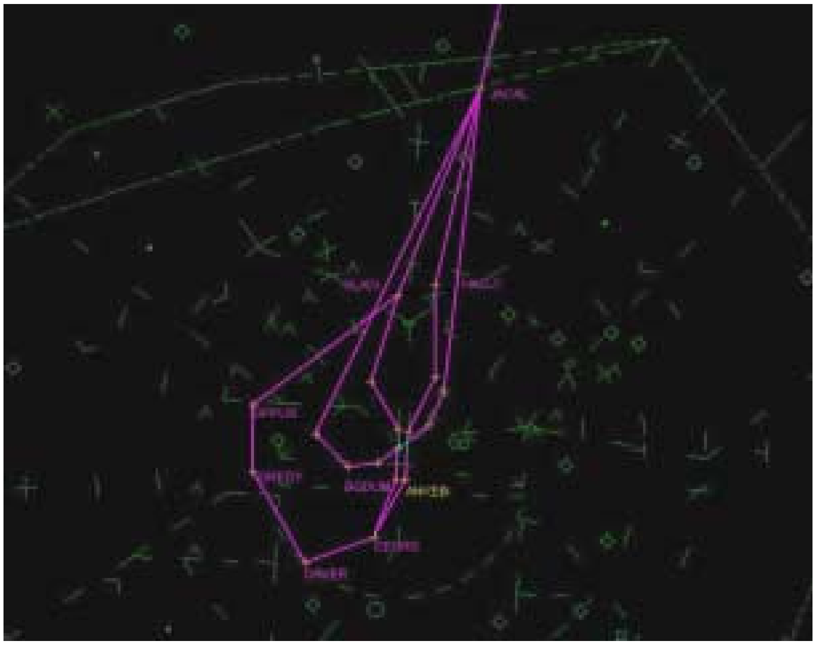
- Determine user participation levels and benefits associated with current and projected usage for both LAADR and TAAP.
- Determine opportunities for benefits and develop additional MOUs with airlines to use LAADR.

- Provide training to controllers, pilots, and dispatch on routes. Develop training materials to outline the differences between these two procedural options, and when they can and should be used.

Key Risks

- Environmental assessment for new routes and adjusted traffic flows may be needed.
- LAADR and TAAP both restrict aircraft to lower altitudes and while potentially providing expedited departure, they may result in increased fuel usage. User participation in TAAP, because it is voluntary, may be limited.

AD-3.2 Routes Independent from Navigation Aids



Scope and Applicability

RNAV allows for the creation of arrival and departure routes (specifically, allowing multiple entry to existing and STAR and multiple exits from Departure Procedures (DPs)) that are independent of present fixes and navigation aids. Airports with complex, multiple runway systems, or with shared or congested departure fixes benefit the most through segregating departures and providing additional routings to reduce in-trail separation increases during climb. Participation and benefits are subject to aircraft equipage levels, pilot/controller education. Radar is required for RNAV operations below FL450 (order 7110.65 5-5-1).

Design, evaluation and implementation of RNAV arrival and departure routes is ongoing across the United States. Current implementation plans include:

- In the near-term, overlay RNAV routes are being developed at EWR, PHL, JFK, CLT, IAH, DTW, and IAD.
- For the mid-term, overlay and non-overlay routes are planned for these and additional sites, including PIT, LAS and PHX (Northwest 2000).
- In the longer-term, RNAV with speed control will be used to support minimal spacing of aircraft on arrival. The controller maintains constant minimum spacing only between back-to-back pairs of RNAV arrivals (both must be equipped to tighten up spacing) through clearances for altitude and speed control procedures. RNAV arrival routes will not change requirements for final approach.
- A national RNAV prioritization plan for arrival/departure procedures is in final review. This will be an addendum to OEP.

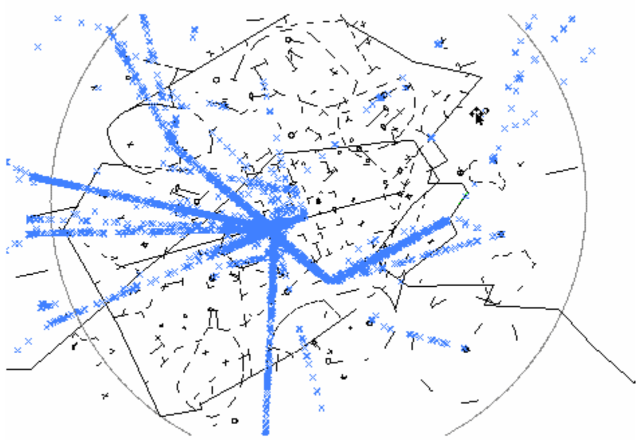
Key Decisions

- Air Traffic and Flight Standards must complete and/or update FAA Orders (STAR/Approach), FAR/CFR's, Advisory Circulars.
- Air Traffic must complete national procedures for RNAV procedure development and implementation.
- Identify and ensure user equipage to deliver desired benefits.
- Manufacturers and users must complete avionics certification for FMC – Required Navigational Performance (RNP), ARINC 424 (for new types).
- Pilot and controller training must be completed. Flight Crew Education includes FMC proficiency, phraseology, and ATC procedures.
- The current RNAV/TARGETS MOU limits use of the TARGETS tool and associated process to 7 sites (EWR, PHL, JFK, CLT, IAH, DTW, and IAD). The MOU will need to be revisited to add additional sites to this process.

Key Risks

- Environmental assessment for new routes and procedures. The implementation timeframe for these projects could increase significantly depending on the level of environmental assessment required by the proposed change.
- Segregated routes based on equipage may penalize non-equipped users. Rulemaking may be required. AOPA has indicated possible acceptance of RNAV equipage being necessary to access major congested airports during specific, limited times of day, but they must maintain access to key GA airports (e.g., Teterboro) located in close proximity to potential RNAV mandated airports.
- Systems that must be in place or may cause risks in delivery include Flight Management Computers (FMC), ATC Host/ARTS automation adaptation and display of RNAV status, and STARS adaptation and display of RNAV status.

AD-3.3 Redesign Terminal Airspace



Improved Terminal Airspace Structure

Scope and Applicability

Terminal airspace optimization (mid-term) and redesign (long-term) projects are ongoing across the United States. Efforts are planned for all major metropolitan areas and congested terminal areas servicing key airports. These include:

- Mid- and long-term, large-scale redesign efforts are being conceptualized in Anchorage, St. Louis, Omaha, New York, Philadelphia, Potomac, Cleveland, Minneapolis, Detroit, Chicago, Bradley, Seattle, Portland, Denver, Cincinnati, Orlando, Charlotte, Houston, Santa Barbara, San Diego, Phoenix, Los Angeles, Las Vegas, Honolulu, and San Francisco. These redesign projects include expansion of terminal airspace (see AD-5), RNAV-base routes (see AD-3.2), arrival and departure corridors, and expanded use of terminal holding. Establishment of arrival reservoirs in the terminal airspace will allow for maximum use of runway capacity.
- Implementation for NY/NJ/PHL Redesign is planned for 2005 and Potomac is planned for 2003. Alternative designs for NY/NJ/PHL and Potomac include optimization using existing infrastructure (tweaking of the current system) and redesign from a "clean-sheet." Redesigned arrival and departure routes will likely be defined as RNAV-based, not dependent on current ground aids. Design concepts include high downwind segments for arrival aircraft, unrestricted departure climbs, fanned departure headings, and VFR flyway corridors.

Key Decisions

- Prioritization of limited resources to support critical terminal area redesign.
- Develop procedures to support airspace design changes. Provide training to controllers, pilots, and dispatch on routes.

Key Risks

- Systems that must be in place or may cause risks in delivery include ATC Host/ARTS automation, WAAS/LAAS, and frequencies for transitioning and new sectors.
- Environmental assessment for new routes and adjusted traffic flows. The implementation timeframe for these projects could increase significantly depending on the level of environmental assessment required by the proposed change.